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United States Department of Agriculture,

OFFICE OF THE SECRETARY—Circular No. 22.

REPORT ON STATEMENTS OF DR. CYRIL G. HOPKINS RELATIVE TO BUREAU OF SOILS.

U. S. DEPARTMENT OF AGRICULTURE,

OFFICE OF ASSISTANT SECRETARY.

Washington, D. C., March 16, 1907.

THE SECRETARY OF AGRICULTURE.

SIR: By your reference I have investigated certain charges against the Bureau of Soils and Professor Whitney, Chief thereof, made in letters of, and in an address by, Dr. Cyril G. Hopkins, President of the Association of Official Agricultural Chemists, and Professor of Agricultural Chemistry and Agronomy in the University of Illinois.

My investigation has been directed to the charges against the honesty and good faith of Professor Whitney and the Bureau of Soils, without regard to the scientific points at issue between that Bureau and Doctor Hopkins.

In an open letter dated March 26, 1906, addressed to Prof. Charles E. Thorne, Director of the Ohio Experiment Station, copies of which were sent to the Secretary of Agriculture, Members of Congress, and various station directors throughout the country, Doctor Hopkins charged—

(1) That the field results of the Ohio station, as stated in Bulletin 167 of that station, do not agree with the results obtained by the pot-culture and water-culture methods of the Bureau of Soils.

(2) That in order to show an apparent agreement between the results of the field experiments of the Ohio station and the results obtained by methods of the Bureau of Soils, material data regarding nitrogen cultures had been suppressed by that Bureau.

(3) Inferentially, Doctor Hopkins charged that the Ohio station authorities were not responsible and did not stand for the results set out in Bulletin 167 of that station, and permitted the conclusions to be included in the said bulletin without their indorsement.

After a careful investigation and a thorough examination of the records and correspondence pertaining thereto, I have found that none of the above charges are justified or warranted.

Further, in an address delivered by Doctor Hopkins in Washington, D. C., on November 7, 1906, before the Association of Official Agricultural Chemists, which address was subsequently printed as Circular

105 of the Agricultural Experiment Station of the University of Illinois, the following direct charge was made by Doctor Hopkins:

(4) The statement of Professor Whitney in Farmers' Bulletin 257 of the U. S. Department of Agriculture, in regard to the results of wheat culture and rotation experiments at Rothamsted, is erroneous and misleading.

I have investigated this charge and have gone over the published records of the Rothamsted station. I find that the statement of Professor Whitney, as found in Farmers' Bulletin 257, is fully justified by the said records, and I conclude that the criticism by Doctor Hopkins is not warranted.

In the same address Doctor Hopkins made use of certain figures and results alleged to be shown by Bulletin 70 of the Agricultural Experiment Station of the University of Minnesota. In this connection I think it only fair to submit to you a letter received by me from Harry Snyder, Professor of Agricultural Chemistry, University of Minnesota. The letter reads as follows:

My attention has only recently been drawn to Professor Hopkins's address, just published as an Illinois station bulletin.

He incorrectly discusses some of our Minnesota work. In the Minnesota report to which he refers there is no discussion whatever of the yields per acre, and he has taken the liberty to draw the conclusion that by continuous wheat production without manures, rotation, or special cultivation of the soil, increased yields of wheat are secured, which is not the case, and is not a system that we have ever advocated; in fact, all of our work and experience has shown just the reverse to be true.

He also infers that no analysis was made of one of the plots. This is incorrect. At the time a large number of analyses were made of the soil at various depths. Different sets of samples were taken by different individuals, so as to determine the extent to which the soil varied in nitrogen content. Other means were also taken to secure strictly comparable results. In preparing the report for the press all of these minor details were omitted, as it was desired to present a report as concise as possible, giving the farmer only the average of the results and the conclusions. All of the old samples we still have on hand in our store room, and the records of the numerous analyses we have made are stored away in our vault. If Professor Hopkins assumed simply for the sake of his argument that no analyses were made, he is entirely wrong, and such a statement is unjust to our experiment station.

Professor Hopkins makes one statement that is in part correct, where he states that the report is not clear as to the comparative depth at which the samples are taken. All of the calculations and conclusions are made on a uniform basis, and this apparent inaccuracy which he claims exists in no way affects the work and conclusions. There is a large amount of interesting data in connection with those experiments relative to the loss and gain of nitrogen of soils which has never been published. In fact, if there is anything in which the work is especially strong, it is in the large number of analyses that have been made.

I have written Professor Hopkins, but get no satisfactory explanation. * * *

I transmit herewith and recommend for publication as a circular of your office a statement in regard to this matter which has been furnished

by Professor Whitney. It is to be understood that my conclusions are not based upon this statement, but, as previously stated, are formed from a personal inspection of the records and correspondence.

Respectfully,

W. M. HAYS,
Assistant Secretary of Agriculture.

Approved:

JAMES WILSON,
Secretary of Agriculture.

STATEMENT BY CHIEF OF BUREAU OF SOILS, REFERRED TO IN
LETTER OF THE ASSISTANT SECRETARY OF AGRICULTURE.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., March 16, 1907.

SIR: In reply to the points contained in the letter of Prof. Cyril G. Hopkins, of March 26, 1906, to Prof. Chas. E. Thorne, and Circular 105 of the Illinois Experiment Station, which you have called to my attention, I submit the following statement:

Professor Hopkins, in his letter of March 26 to Prof. Charles E. Thorne, recalculates the results of the Ohio Agricultural Experiment Station wheat yields for nine years and those obtained by the Bureau of Soils with pot and water-culture experiments, and after commenting on the comparison between these recalculated results makes the following statement:

Considering this almost absolute disagreement between the Bureau of Soils' "rapid-fire" results and the Ohio station's nine-years' field work, it is at least surprising to find that the identical data from which the above tables are constructed can be manipulated so as to furnish figures regarding which the following statements can be made by the Bureau of Soils. * * *

That Professor Hopkins is wholly unjustified in his comparison between the field results of the Ohio station and the results obtained by the methods of the Bureau and in charging manipulation of the figures is obvious from a careful reading of Bulletin 167 of the Ohio station and the following statements.

The Bureau's work in Ohio, as stated in the bulletin, was not carried on in the actual soil of the fertility plots, as assumed by Hopkins, since this would have seriously disturbed the condition of the plots, for the reason that it would have required about 200 pounds of soil from each of the one-tenth-acre plots for the examination contemplated. The soil actually used was from an unoccupied piece of land, which had been manured a short time previously, situated about one-half mile from the

fertilizer plots, and from a similar piece of land somewhat nearer the plots, but considered by the Ohio station to be the poorest soil on the experiment station farm. The soils are described on page 93 of Bulletin 167 of the Ohio station. Although the soil actually used was carefully and specifically described in the bulletin, Professor Hopkins undertakes a detailed and direct comparison of the results obtained with it to the results obtained on the fertility plots by Professor Thorne, a comparison so obviously improper that it was not attempted by the authors of the bulletin.

A single set of samples of about 5 pounds each was taken from each of the fertilizer plots for a comparative test in the wire baskets, but a week of heavy rain and a leaky greenhouse spoiled the results. Since, therefore, the only soil available for the basket cultures had recently received a heavy application of manure, it did not seem advisable to Professor Thorne to make any test with nitrates. On the other hand, Professor Hopkins's method of calculating what the effect of nitrate would have been if used alone by subtracting the results of the separate effects of potash and phosphates and attributing the remainder to nitrates is wholly unscientific and unjustifiable, and Professor Hopkins justified it (page 12, Circular 105 of the Agricultural Experiment Station of the University of Illinois) only by stating that it is the only method which he could use. However justifiable such a method may be for computing money values, it obviously has no value in computing fertilizer effects, since it is conceded by all authorities that the effects of fertilizers are not usually additive, but that the influence of one fertilizer almost invariably modifies the effect which a second fertilizer would have, had it been added alone. Indeed, the numerous values obtained for nitrogen by Professor Hopkins (Table IV, Circular 105) illustrate this point remarkably well, the value of nitrogen varying from 0.49 to 5.44, and similarly for phosphates and potash salts.

In the bottle-culture work the extracts were made from a soil taken from a strip along the ends but outside of the plots devoted to the five-year rotation experiments, as well as from plot 1, the unfertilized plot of the rotation field. With these experiments also, however, it is perfectly obvious that a comparison of the improperly calculated values obtained by Professor Hopkins can not be considered in any way a contradiction of the comparison of the observed results made by the authors of Bulletin 167.

Therefore I would state that with the pot culture a direct comparison could not be made, and none was attempted, because of the origin of the soil samples. With the water cultures the observed results do compare with the field-plot results, although the improperly calculated results of Hopkins do not.

In Hopkins's letter to Thorne he makes the following statement :

By some oversight or foresight the test with nitrogen alone is not considered by the Bureau of Soils, * * *

claiming,

It is difficult to imagine a more discordant comparison than is here exhibited,
* * *

and adding this question,

In case of two marked discrepancies, is it better to suppress both or to submit one and suppress the other?

The charge is based on the fact that no comparison was made between the nine-year field average and the bottle culture in the case of nitrates. The explanation is as follows:

Professor Thorne's experience, as mentioned in his several reports, is that when commercial fertilizers are first applied to the soils at Wooster they readily respond to nitrates, but much less readily to phosphates until after several annual applications, but that with continuous applications the relatively high value of nitrate applications becomes very much lowered, and the results obtained by pot or bottle cultures for nitrates could not be properly compared with the nine-year field averages for nitrates. Therefore, owing to this objection of Professor Thorne's, made previous to the assembling of the data, the authors of the bulletin did not consider it proper to introduce this value into the comparison made in Table 16 of the Ohio bulletin, quoted in Table III, Circular 105 of the Illinois station.

In the letter from Professor Hopkins under date of March 26, 1906, to Professor Thorne, the following statement occurs, which was also inferentially contained in Professor Hopkins's address before the Association of Official Agricultural Chemists:

I understand, of course, that the Ohio Experiment Station is not responsible for either the work or conclusions of the Bureau of Soils, even though out of courtesy and in unsuspecting honesty you have permitted the publication of these bulletins from your station, the work having been done at Wooster and on Ohio soils.

The reasons for sending the party from the Bureau of Soils to the Ohio Experiment Station, and the general terms under which they went, were certainly known to Professor Hopkins. A similar offer had been made to him to work under his observation and control with the Bureau's methods in his laboratory on some of his field problems.

That he made this insinuation—virtually a charge of discourtesy and dishonesty on our part against the Ohio station—without basis is evident from the following statements:

In December, 1904, a conference was held in my office with several station directors interested in soil investigations, and a proposition was made and accepted that a party be sent out from the Bureau of Soils equipped with the necessary apparatus to make an investigation of the

soils and the manurial requirements thereof at two of the experiment stations where the work could be under the personal observation and control of the directors, and where the methods could be critically examined. Director Thorne, under date of January 2, 1905, wrote me as follows:

One of us understood you to propose only to apply your method in the investigations at our respective stations to the determining whether one soil is more or less productive than another, while the others understood, or at least assumed, that you expected to endeavor to determine the cause of the difference in productiveness in the hope of being able to suggest practical methods of amelioration in a shorter time than it is possible through the ordinary field test, and that you propose to carry the investigation further than the familiar pot experiment with fertilizing materials in that while using such materials you will also conduct investigations on methods of improving the physical condition of the soil.

If the first understanding should be the correct one, I do not care to go any further in the matter; but if the second assumption is correct, then I shall be glad to assist in carrying on the investigations to the limit of the available resources of our station.

In reply, under date of January 4, 1905, I wrote Professor Thorne a long letter outlining specifically the scope of the work and stating—

The work of the party will be at all times accessible to you or to your assistants, and the results will be turned over to you for your inspection or use at such times as you desire.

On January 6, 1905, Director Thorne wrote—

Your proposition regarding the work on soils at this station is entirely satisfactory to me.

On January 13, 1905, he again wrote that the proposition was satisfactory to the board of control of the Ohio station.

In a letter to one of the other gentlemen who had taken part in the conference and who was about to cooperate with the Bureau I stated in even more specific terms the purpose of sending the parties to these stations—

You are entirely correct in stating that it is my earnest wish to have our methods of work and our line of thought and reasoning subjected to a very critical study at some place outside of Washington where the soil conditions and crop yields are known from a long-continued field observation.

In order to make the relation between the Ohio station and the Bureau of Soils still more specific, before the work on the experimental plots at Wooster had been concluded and before the report had been written an informal contract was entered into with the director of the Ohio station, under date of June 2, 1905, covering also the investigation of the Strongsville soils to be undertaken at the request of the director of the Ohio station, in which the following provisions appear:

The party will be located at Wooster, Ohio, but may be temporarily sent to Strongsville or such other locations as the director may find desirable for the proper prosecution of the work. * * *

In so far as compatible with the proper interests of the work, the members of the party will be subject to the usual regulations of this Department, but the disposition of their working time is at the discretion of the director of the Ohio station, who assumes responsibility for the same. * * *

The work of the party of the Bureau of Soils shall consist in the application of the wire-basket and water-culture methods devised by the Bureau to such problems presented by the Strongsville soils as the director of the Ohio station may direct. An outline of all proposed work and a weekly report of the progress of the work is to be furnished the Bureau of Soils. The Bureau will give such suggestions, advice, and other assistance as it may deem proper, but the acceptance of any such assistance will be in the discretion of the director of the Ohio station, with whom the responsibility for the work rests. * * *

Mr. Snyder shall immediately prepare a report of the work of the party of the Bureau of Soils upon the Wooster soils, with such added data and such assistance as the Ohio station and the Bureau may be able to give him. Upon the completion of this report it shall be published as shall be mutually agreed upon, either as a bulletin of the Ohio station or, together with the added introduction by the director of the Ohio station, as a regular publication of the Bureau of Soils.

On October 2, 1905, Mr. Snyder, one of the authors of the bulletin, wrote me—

I am sending the manuscript of the paper on Wooster soils, which Professor Thorne has gone over thoroughly and has added a few notes. I have also added the data from a rotation experiment which has been completed since the paper was written, and which I thought might be worth inserting.

On October 6, 1905, four days later, this manuscript was returned to Mr. Snyder with the statement—

We have gone over the paper and inserted the material suggested by Professor Thorne in what seems to us a very satisfactory way. You will, of course, advise Professor Thorne that this is merely a suggestion on our part, but what seems to us the best disposition of the [his] added material, which we think strengthens the paper. * * *

We had expected there would be an introduction by Professor Thorne to go with this bulletin, and we would like to be advised if Professor Thorne contemplates such an introduction. * * *

You will express to Professor Thorne our gratification at the outcome of this work, and ask that a copy of the proof sheets be submitted to us for any suggestions or corrections that may occur to us when the paper is in that form before finally going to press.

On October 18, 1905, Mr. Snyder wrote me that Professor Thorne—

Told me yesterday that he was ready to give the paper on the Wooster soils to the printer as soon as the [his] preface was returned from the Bureau.

The day before, October 17, 1905, I had written Professor Thorne—

I have gone over the preface which you sent me a few days ago, and I think it very satisfactory. I have no suggestions to offer, and the manuscript is returned herewith.

On October 14, 1905, Professor Thorne wrote me as follows:

I have carefully studied the report on the basket-culture soil investigations which have been made by your Bureau in cooperation with this station during

the past season, and I believe that this method of investigation will be found to be a very useful adjunct to the methods hitherto employed in the study of soils. I am so fully convinced of this point that I shall endeavor to procure for this station the erection of a building to be devoted exclusively to soil investigations, with a view to making use of your method as one of the leading features of the work.

There seems to be no necessity of further comment upon Professor Hopkins's treatment of the Ohio station matter.

In Circular 105 of the Illinois station, however, Professor Hopkins attacks my use of certain Rothamsted data in an address published in Farmers' Bulletin 257 of the U. S. Department of Agriculture. On page 22 of Farmers' Bulletin 257 I made the following statement, based on the Rothamsted results:

In other experiments of Lawes and Gilbert they have maintained for fifty years a yield of about 30 bushels of wheat continuously on the same soil where a complete fertilizer has been used. They have seen their yield go down where wheat followed wheat without fertilizers for fifty years in succession from 30 bushels to 12 bushels, which is what they are now getting annually from their unfertilized wheat plot. With a rotation of crops without fertilizers they have also maintained their yield for fifty years at 30 bushels, so that the effect of rotation has in such case been identical with that of fertilization.

On page 21 of Circular 105 of the Illinois station Professor Hopkins, in referring to this statement of mine, says:

It is embarrassing to offer comment upon these statements. Instead of 30 bushels with the unfertilized rotation wheat, the average yield is only 27 bushels per acre; and, instead of 30 bushels with the best fertilized continuous wheat, the average yield is 37 bushels per acre. In other words, the statement "that the effect of rotation has in such case been identical with that of fertilization" is far from the truth. * * *

Professor Hopkins has apparently only studied the tabulated results and is not familiar with the papers of the Rothamsted station and the early controversy with Liebig, in which they admitted, in reply to Liebig's charge that they were operating on a fertile piece of land, that when they began their operations their soil was similar to the soil of surrounding farms which were yielding from 25 to 27 bushels of wheat, although they admit that others estimate the average yield at 30 bushels, and that they had purposely farmed this land for a few years so as to rid it of all influence of any previous fertilizers or manures. Lawes and Gilbert's own statement in regard to this matter, as taken from the "Report of Experiments on the Growth of Wheat for Twenty Years in Succession on the Same Land," published in 1864, is as follows:

The experiments have been made upon what may be called fair, average wheat land. But, as the rental of similar land in the immediate locality ranges, and has ranged for many years past, only from 25 s. to 30 s. per acre, tithe free, and its wheat crop under the ordinary management of the district certainly does not average more than from 25 to 27 bushels per acre once every five years, it is obvious that, in a practical point of view, it can lay no claim to extraordinary

fertility or to be ranked on a higher level than a large proportion of the soils on which wheat is grown with a moderate degree of success under a system of rotation and home manuring. Such, in an agricultural or commercial point of view, were the general characters of the land. * * *

For the experiments upon wheat a field of 14 acres was selected, which had grown turnips, barley, peas, wheat, and oats since the application of manure, and would therefore, *according to the ordinary rules of practice, be considered so far exhausted as to require to be remanured before growing another crop.*¹

It was thought that a field in such a condition was peculiarly fitted to show in which of the constituents of the crop to be grown the soil had become practically the most deficient by the removal of the five preceding crops, and that, if on some plots of the land, *in this agricultural sense exhausted*,¹ certain constituents of farmyard manure were supplied separately, on others in combination, and if, on others by their side, the crop were grown respectively without manure, and with farmyard manure itself, the comparative results obtained would far more satisfactorily indicate what constituents were the most exhausted, so far as their available supply for the crop to be grown was concerned, than any analysis of the soil could do. * * *

It will be observed that notwithstanding the very favorable report of the year's crop, the produce in these experiments was, without manure, only 15 bushels, and with farmyard manure scarcely 20½ bushels, of dressed corn, with proportionally small amounts of straw. *These low results afford satisfactory evidence that the land was in a condition of practical or agricultural exhaustion*; ¹ and hence, that it was well fitted for the purpose of experiments the object of which was to show in what constituent or class of constituents the soil had become, by the previous course of cropping, the most deficient, so far as the requirements of the wheat crop were concerned.

Again, in their "Report of Experiments on the Growth of Wheat, for the Second Period of Twenty Years in Succession on the Same Land," published in 1885, they say:

The last time this land received any manure was in 1839. The crop, which was then turnips, was followed by barley, peas, wheat, and oats, the last four crops being grown without any manure whatever. In the event of a failure of the clover crop, such a course would not at that period have been unusual in the district, although in those days a top-dressing of soot would, in all probability, have been applied to the wheat. In this case, however, it was not applied; and, even if it had been applied, *the land after the oat crop would be considered, agriculturally speaking, to be exhausted.*¹

It was at this period that the Rothamsted experiments were commenced,¹ for the purpose of ascertaining what amount of crop the land would yield in wheat, without the aid of manure. * * *

The average yield of wheat in Great Britain is estimated by us at 28 bushels and by others at 30 bushels per acre.

The above quotations show that the land was already agriculturally exhausted when the first recorded crop of 15 bushels was obtained, which value Doctor Hopkins uses as the basis for criticizing my statement. They further show that the land had originally yielded 25 to 27 bushels. A much better illustration of this decline in crop production is shown by another experiment quoted on page 54 of the report just

¹ Italics mine.—M. W.

mentioned, where the following table is given of records from 1863 to 1883, inclusive:

Year.	Dressed corn in bushels per acre.		Year.	Dressed corn in bushels per acre.	
	Plot 5, minerals alone.	Plot 16, minerals and 172 pounds nitrogen.		Plot 5, minerals alone.	Plot 16, minerals and 172 pounds nitrogen.
1863.....	19 $\frac{3}{8}$	55 $\frac{7}{8}$	1873.....	<i>Minerals.</i> 12 $\frac{3}{4}$	<i>Unmanured.</i> 12 $\frac{3}{4}$
1864.....	16 $\frac{3}{8}$	51 $\frac{1}{8}$	1874.....	13	11 $\frac{3}{8}$
	<i>Minerals.</i>	<i>Unmanured.</i>	1875.....	9 $\frac{1}{2}$	10 $\frac{3}{8}$
1865.....	14 $\frac{1}{2}$	32 $\frac{3}{8}$	1876.....	10 $\frac{3}{8}$	11
1866.....	13 $\frac{1}{2}$	17 $\frac{3}{8}$	1877.....	11 $\frac{1}{8}$	9 $\frac{7}{8}$
1867.....	9 $\frac{1}{2}$	14 $\frac{3}{8}$	1878.....	14 $\frac{1}{2}$	13 $\frac{3}{8}$
1868.....	17 $\frac{3}{8}$	22 $\frac{3}{8}$	1879.....	5 $\frac{3}{8}$	4 $\frac{3}{8}$
1869.....	15 $\frac{3}{8}$	16 $\frac{3}{8}$	1880.....	17 $\frac{1}{2}$	14 $\frac{3}{8}$
1870.....	18 $\frac{3}{8}$	18 $\frac{1}{2}$	1881.....	12 $\frac{3}{4}$	13 $\frac{3}{8}$
1871.....	11 $\frac{1}{2}$	13 $\frac{3}{8}$	1882.....	12 $\frac{3}{8}$	10 $\frac{3}{8}$
1872.....	12 $\frac{3}{8}$	13 $\frac{3}{8}$	1883.....	15 $\frac{3}{8}$	15 $\frac{3}{8}$

On plot 16 the yield of wheat had been forced by heavy applications of fertilizers until it produced in 1863 and 1864 55 $\frac{7}{8}$ bushels and 51 $\frac{1}{8}$ bushels, respectively. The plot was then left unmanured, being continuously in wheat, and the yield fell from 32 $\frac{3}{8}$ bushels in 1865 to 13 $\frac{1}{2}$, 10 $\frac{3}{8}$, and 15 $\frac{1}{8}$ bushels in the last three years, respectively, with similar fluctuations in preceding years due undoubtedly to climatic conditions.

From the foregoing quotations it is clear that the statement that the yield fell from 30 to 12 bushels is entirely justified.

Again, on page 22, Farmers' Bulletin 257, I state—

In other experiments of Lawes and Gilbert they have maintained for fifty years a yield of about 30 bushels of wheat continuously on the same soil where a complete fertilizer has been used.

To which Professor Hopkins also takes exception in the terms above cited, stating—

Instead of 30 bushels with the best fertilized continuous wheat, the average yield is 37 bushels per acre.

In making this criticism Professor Hopkins takes the average yield of the fertilizer plot giving the highest yield. In Farmers' Bulletin 257 I referred to the fertilizer tests in general terms, using all the results where complete fertilizers were used. In the "Plans and Summary Tables of the Lawes Agricultural Trust," published in 1902, there are seven plots upon which complete fertilizers are used. The average yield for fifty years, from 1852 to 1901, from these plots receiving complete fertilizers, are as follows:

Plot.	Yield.
No.	<i>Bushels.</i>
6.....	24
7.....	32 $\frac{3}{8}$
8.....	37
9.....	29 $\frac{3}{8}$
13.....	31 $\frac{1}{2}$
15.....	30 $\frac{3}{8}$
16.....	34 $\frac{1}{2}$
Average.....	31 $\frac{1}{8}$

It will be seen that two of these yields are below the figure used by me, one is practically the same, and four are higher, the actual average of all the plots being $31\frac{3}{4}$ bushels instead of 30 bushels, as I stated. It would have been manifestly unfair to have used the best result cited by Professor Hopkins, namely, 37, to illustrate the generalization I was making in Farmers' Bulletin 257, just as it would have been unfair to have used the lowest, namely, 24.

In regard to the statement of the yield of wheat under rotation being maintained for fifty years at 30 bushels, which statement Professor Hopkins also criticises, it will be seen from the actual figures here given from the Annual Memoranda published by the Rothamsted station in 1901 that such a statement is fully justified.

Year.	Bushels.	Year.	Bushels.
1851.....	$30\frac{1}{2}$	1879.....	$10\frac{1}{2}$
1855.....	$37\frac{1}{2}$	1883.....	$33\frac{1}{2}$
1859.....	$35\frac{1}{2}$	1887.....	$34\frac{1}{2}$
1863.....	45	1891.....	32
1867.....	$27\frac{1}{2}$	1895.....	$21\frac{3}{4}$
1871.....	$11\frac{1}{2}$	1899.....	$26\frac{3}{4}$
1875.....	$24\frac{3}{4}$		

The average for the recorded crops in this rotation for the half century is $28\frac{1}{2}$ bushels, the last five crops since 1883 being, in fact, $33\frac{1}{2}$, $34\frac{3}{4}$, 32, $21\frac{3}{4}$, and $26\frac{3}{4}$, respectively.

The difference in the extremes of the entire series for fifty years, namely, from 45 bushels to $10\frac{1}{2}$ bushels, is approximately 35 bushels, which is greater than the average yield of $28\frac{1}{2}$ bushels for the entire period.

Professor Hopkins further objects that in considering the wheat yield I did not cite the fact that the barley and root crops in rotations did not show results parallel to the wheat.

There seems nothing remarkable that a rotation that would be suitable to and would maintain the yield of wheat would be less well adapted to barley or turnips. It might with justice be asked why, if the soil contains sufficient plant food for an average crop of $28\frac{1}{2}$ bushels of wheat from 1851 to 1899, turnips should starve for lack of sufficient plant food. The failure of the turnip crop may be explained in other ways, but not logically on this ground. According to Sir John Lawes (see Jour. Royal Agric. Soc., Vol. VIII, p. 231), the texture of the soil was too heavy for good turnips or good barley. His actual words are—

The soil upon which my experiments were tried consists of rather a heavy loam resting upon chalk, capable of producing good wheat when well manured, not sufficiently heavy for beans, but too heavy for good turnips or barley.

I submit that Professor Hopkins was wholly unwarranted and unjustified in the statements and charges he has made in the letter and circular above referred to.

Finally, I would submit to your attention that it is entirely improper to make public documents a vehicle for personal and political attacks. It is equally improper to use an official position in a National organization affiliated with the U. S. Department of Agriculture as an opportunity for such personal ends.

Respectfully.

MILTON WHITNEY,
Chief of Bureau of Soils.

Hon. JAMES WILSON,
Secretary of Agriculture.

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